55

A
SHORT HISTORICAL ACCOUNT
OF THE
INVENTION, THEORY, AND PRACTICE,
OF
FIRE-MACHINERY.

[PRICE ONE SHILLING.]

BRITISH MUSEUM

A
SHORT HISTORICAL ACCOUNT
OF THE
INVENTION, THEORY, AND PRACTICE,
OF
FIRE-MACHINERY;
OR
INTRODUCTION TO THE ART OF MAKING MACHINES, VULGARLY CALLED STEAM-ENGINES.

In order to extract Water from Mines, convey it to Towns, and *Jets D'Eaux* in Gardens. To procure Water-falls for Fulling, Hammering, Stamping, Rolling, and Corn, Mills, &c. To give Motion to all ſorts of Machinery worked by Men or Horſes, and bring in and out of Port Veſſels in Calms, and againſt the Wind in moderate Weather.

WITH

Two Letters, by the Author, which give an Account how Nature and bad Engineering tend to the Deſtruction of the Port of Amſterdam; and how the extracting the ſtagnated and ſtinking Waters, and bringing freſh to circulate in the Canals of that City, was oppoſed.

k

By Mr. BLAKEY.

LONDON:

PRINTED IN THE YEAR

1793.

BRITISH MUSEUM

PREFACE.

THE intent of this ſhort account of the Invention of Fire-Machinery is to give an idea of the powers to be obtained by heat and cold when they act alternately, and will ſerve for an introduction to the *Hiſtory, Theory*, and *Art*, of Fire-Machinery in the ſimple manner which principles of nature indicate.

The preſent complicated mode of making theſe Engines, is occaſioned by ſuppoſing that all the power which is to be obtained by Fire-Machinery, can only be found in the mechanical ſyſtem of the Lever-Engine, invented by Newcomen and Cawley, near a century paſt. From ſuch notions, the Fire-Engine builders have done nothing worth notice but in amendments of workmanſhip, to augment the price of their contrivances, and even combine to diſapprove what may put them out of the heavy method, which anſwers their ends.

In order to give ſome illuſtrations reſpecting what can be done with Fire Machinery, I ſhall mention, in a general manner, how it is made uſe of for extracting water from *Mines*; and for working *Mills* by Water-falls, and ſuch as are put in motion with Fire Engines of the *ſimple kind*.

91

Engines for extracting water from mines, are ſo expenſive, that many proprietors of mines cannot purchaſe them; beſides, they are very difficult to make and to ſet up, and require continual repair, as every one knows. One of them in Cornwal coſt £.12,000 in erection, and conſumes coals to the value of £.5,000 every year; it has ſo much tackle that the whole weight of what is put in motion is no leſs than *two hundred tons*, as I was informed by one of the proprietors.

Such complications proceed from the not underſtanding the principles of power which nature lays before us, and which are no other than *heat* and *cold*, with the *elaſticity* of air. With theſe the Greeks were well acquainted, as appears by what has eſcaped the ravages of barbarous ages, and which will be ſeen in my Academical Works.

When we conſider the ſimplicity of theſe powers, and yet ſee Engine-builders hold ſo faſt to their mechanical method of *great piſtons*, working in monſtrous *cylinders*, with *pump-rods*, and a multiplicity of leather *buckets*, wearing out from *friction*;—when we ſee great *beams* carry chains to move ſuch coloſſal inſtruments, and *capſtands* to move the leaſt part of this heavy tackle, we are inclined to think, that the great architect *Vitruvius* was in the right when he ſaid the ſcience of mechanics is for labourers, but the combination of the principles of nature belongs to ingenuity.

Let us look at Water-Mills, eſpecially thoſe for grinding corn: their proprietors have done their beſt to bring them to the utmoſt perfection; nevertheleſs, they are ſo complicated, and require ſo much art to proportion their wheel-work to the diameter of their ſtones, in order to have the true velocity for good grinding, that few are found to be ſo properly contrived as to anſwer theſe ends.

After all the care and expence theſe mills require, they are ſubject to many inconveniences. They are often ſtopped for want of water in Summer, from froſts in Winter, and from floods and ſtorms which overſet them; beſides, that three-fourths of theſe Mills are ſet up in ſuch places as are difficult to be come at, from the neceſſity of building them where water-falls are to be had.

Tide-Mills are yet more difficult to be kept in good order, they require great and expenſive works to make them ſerviceable; beſides this, they can work but when the water is running out; and, even then, they loſe their power as the water falleth; whence theſe Mills work not much more than four hours in twelve with equal velocity, let the art of the miller be ever ſo great in managing his head-water.

Theſe inconveniences are not found in Mills worked by Fire Engines of the ſimple kind. The prime coſt of a Fire Engine, of this ſort, will not equal the price of the land which muſt be waſted in damming up water for the uſe of the mill.—Theſe Engines conſume little fuel; thoſe for grinding corn do not require much more heat than what proceeds from the oven while it is heating, and need only one faggot or two, at moſt, to make the mill grind more corn than the oven can bake in bread at one heating; but, if four ovens are made to bake conſtantly in equal time, one after the other, there is no need of additional faggots, by which means the fuel for working the Engine occaſions no expence. Such mills alſo can be erected where they are the moſt wanted, and ſave all the expences and different carriage to the mill and back again, as any one may have them on their own grounds.

The want of Fire Engines for manufactories is ſo great, that the maſters of works pay from 1,500 to £. 4000 and upwards for thoſe now in common uſe. If the price of them were as moderate as the nature of their principles of power point out, an infinite number of manufacturers would have them ſooner than horſe-engines, which are much dearer than the ſimplified Fire Engines here treated of; as theſe can be made from the ſmalleſt ſize to the largeſt, are of the completeſt utility, and produce at the ſame time every proportionable effect in all ſorts of works.

A SHORT

A SHORT HISTORICAL ACCOUNT OF THE INVENTION OF FIRE-MACHINERY, &c.

IN the beginning of the ſeventeenth century, a modern Philoſopher conceived the notion of making uſe of fire and water to obtain motion. This was Brancas of Rome, who contrived a ſtamping-mill to be worked by ſteam, coming from a large æolipile, as may be ſeen in his twenty-fifth plate. We are obliged to him for a number of ingenious inventions, which he dedicated to M. Canci, governor of Loretto, in 1628, and publiſhed his work at Rome the year following.

Thirty-four years after, the Marquis of Worceſter publiſhed a little treatiſe, under the name of "Century of Inventions, printed in London, 1663;" he gave them as if he had tried them, and propoſed other engines of great utility, which only wanted encouragement from government: "Several were nothing but projects," ſays Deſagulier, "but, where he is more explicit, there is one for raiſing "water by means of fire."

In the acts of Leipzig, 1690, p. 410, is to be ſeen an invention, intituled, "A new manner to procure a conſiderable "quantity of power with little expence, by Dr. Papin." "In "this new engine," he ſays, "of which we have given a "deſcription in the acts of Leipzig, 1688, and the intent of "which was to obtain a new method of making uſe of "gunpowder as a power to give motion, the chief fault "was, that the gun-powder, in the under part of the tube, "did not entirely fill the capacity of this tube, ſo as to have "no air under the piſton *." Papin continues to give reaſons like a man of great underſtanding; but as there muſt be plates and deſcriptions to explain the whole, I ſhall ſay no more on the ſubject, but only add, that the doctor did his beſt to obtain his end in another manner. He ſhews that, with "A little water changed into ſteam by means of fire, "we can have an elaſtic power like air; but that it totally "diſappears when chilled, and changes into water; by which "means he perceived, that he could contrive a machine in "ſuch a manner, that, with a little fire, he would be able, at "a ſmall expence, to have a perfect vacuum, which could not "be obtained with gun-powder." Among various contrivances, this appeared to anſwer the beſt. In the work itſelf a plate of this contrivance will be given, which, however, is not to be compared to what has been invented ſince Papin, by men who had never heard of him, and were altogether much inferior to him in theoretical and practical philoſophy.

In 1699, a remarkable year for the honour of Engliſh ingenuity, Captain Savery ſhewed to the Royal Society an engine which raiſed water by means of the expanſion and condenſation of ſteam; he publiſhed a little treatiſe, which he named "The Miners Friend;" the deſcription of this engine is to be ſeen in Harris's Dictionary of Arts, &c. printed in London, 1704. This learned man ſays of Savery's engine, "that with little art it can be kept in action as long "as one will, and that it cannot be hurt but by ſtupidity and "negligence." Harris looked on this invention of Savery's to be one of the moſt ingenious combinations that had ever been made in hydraulics, and I may add, that it is ſurpriſing that a ſeafaring gentleman, in all likelihood little uſed to the working of metals, ſhould have brought his invention to the perfection he left it in.

In the memoirs of the Academy of Sciences at Paris, page 112, 1699, is to be ſeen an account of Mr. Amanton, who ſhewed the drawing of an engine, in which fire heated air, which was to force up water on a wheel, to make it turn. We ſuppoſe he underſtood his theory; but to me it appears impracticable, though it muſt be ſaid that Monſieur Amanton's notions are ingenious and uſeful for thoſe who deſire to know

---

* It is ſeen that Papin is the firſt who thought of a piſton to be applied in Fire Machinery, though it was but in a tube about two inches diameter, yet it ſhewed the utility of piſtons, which the ancient Greeks knew as well as the moderns, being one of the moſt ſimple inventions in hydraulics, as may be ſeen in Virtruvius, ſpeaking of the pumps of Cteſibus for the forcing water to a great height.

to what degree the expanſion of air, for procuring power, can be brought to.

There is alſo ſeen in the ſame Academy's works, "Mr. "D'Aleſme's propoſal to raiſe water by means of ſteam, "proceeding from hot water; in a machine (a ſort of "æolipile) in which the elaſticity of the ſteam makes the "water ſpout to a great height, ſo ſtrong is that expanſive "power." Auguſt 5, 1705.

In 1707, the famous Papin publiſhed, at Caſſel, a treatiſe on a new machine for raiſing water by means of fire; he thought his manner was better than Savery's. He ſays, "All "the world ſhall know that it is the Landgrave of Heſſe "to whom this invention is due, and by him it was brought "to the perfection it is in, though many obſtacles were "found in the execution."

I cannot help remarking, what a pity it is that ſuch an ingenious man as Papin ſhould take ſo much pains to acquire the reputation of being the firſt in the invention of Fire-Machinery. To appear leſs partial, he takes from his own merit to flatter the landgrave, who certainly did not underſtand thoſe matters ſo well as he: but, notwithſtanding the conſideration that is due to a ſovereign and to the celebrated Papin, I make bold to ſay, that his engine was far from having the merit of Savery's; and I can ſay more, experience has made me believe that no man has ſeen the doctor's engine work a couple of hours, as may be conceived from the difficulty he found in making ſteam, and encreaſing its elaſtic power in his receiver. Papin has nevertheleſs given us demonſtration in upwards of forty pages of calculations, which prove his underſtanding and learning. This machine is in my academical works.

In 1710, Thomas Newcomen, ironmonger, and John Cawley, glaſier, at Dartmouth, contrived to work a piſton in a cylinder, by the weight of the atmoſphere only, when they had formed a vacuum in their veſſel; but it took them much time to bring ſuch a complication of apparatus to perfection, for which they were criticiſed more out of jealouſy than reaſon; however, they brought their engine to perform by hand as well as poſſible for that time, much to their honour, as well as to that of a country boy whoſe name was Humphry Potter, and who, to give himſelf time to play, contrived tackles to make the engine work itſelf.

The bringing this engine to perform as it did proves, that, when nature is ingenious, it finds out the way to come to its ends without the humdrum pedantry of ſchools. An ironmonger, a glaſier, and a country boy, brought to perfection the lever fire-engine, which all the univerſities and academies of Europe had not the leaſt notion of before theſe ingenious mortals appeared. This diſcovery has not been improved but in acceſſaries, and by no means as to principles, as theſe are more ſimple, and can work with leſs fuel than thoſe ſo much vaunted, if care is taken in making them.

As ſoon as theſe happy inventions came to light, Beighton, another ingenious man, ſtept forth and made tables for the dimenſions of veſſels, in proportion to the weight of the atmoſphere, which proportions are followed to this day. This has made the world believe that the whole art of Fire-Machinery is concentered in Newcomen and Cawley's lever-engine.

In 1718, Doctor Deſaguliers made an amendment (according to him) on Savery's engine; but his method was not followed, as it cauſed the death of the manager; which muſt often happen when the dimenſions are in the manner he contrived them.

After this engine, Mr. Moura, a Portugueſe gentleman, invented ſome geers to make an engine, on Savery's principles, to work itſelf: they were ingenious, but too complicated to be put in practice.

The making a fire-engine for York-buildings gave an opportunity to improve as to the manual part, and to be leſs expenſive.

Experience in making fire-engines has brought Mr. Darby, of Colebrook-dale, to make the cylinders large enough to have a vacuum in them, equal to the weight of 80,000 lb. of atmoſphere, ten and fifteen times in a minute. This perfection of workmanſhip has procured to England a great exportation of cylinders, pipes, &c. to many parts of Europe and America. At Liege, and in the Netherlands, they uſed to have their cylinders from England; but, being very expenſive from the duties and carriage, &c. the induſtrious Poſſon, at Liege, with his ſmall foundry, found means to make cylinders of three pieces ſcrewed together, which he bored, and made them ſerve as well as if they were of one piece. I have ſeen one work as well as can be deſired.

In 1752, Monſieur Rivatz, a Swiſs gentleman, made a fire-engine on Savery's principles for the Chevalier Nugue, at *Nogent ſur Marne*, two leagues from Paris; the apparatus to make the engine work itſelf was of his invention, and performed very well; his boiler, however, being out of proportion,

portion, the man who attended the work was much hurt by the exploſion of the ſteam, which diſcredited the machine, though well contrived in every part except the boiler.

Two years after, I compoſed ſome engines, in drawings, by way of ſpeculation; but, in the year 1760, I made one to water my garden; it was ſo contrived that the injection-water came from the ſuction-pipe, by which means I ſaved the expence of a lofty reſervoir, and all the apparatus which attend the jack-pumps. This manner of injection is ſimple, and ſo much out of the common way, that I believe nobody has conceived it fully, even after having ſeen the engine work ſeveral hours. Its deſcription is in my academical works, with the improvements I have made ſince.

In the ſame engine, I made uſe of air as an intermedium between cold water and ſteam. This led me to invent another on Grecian principles, which, with only an eighteen-inch fall, raiſed water thirteen feet and a half high. I could have made the water riſe more than forty feet, or double that, with the ſame principles *. The deſcription of theſe inventions are in my academical works.

In 1765, I made a working model, in London, on the principles of that with which I watered my garden. It was copied in part, and applied at the ſilk-mill at Derby, which I ſaw two years after; but it had not the ſimple way of injection, for want of having perceived that effect in the original. I likewiſe made an engine for my friend Ferguſſon; it acted only by the expanſion of ſteam on an intermedium of air, which made the water ſpout more than thirty feet, though the boiler was but ſix inches in diameter; it could have forced the water higher. I had occaſion to ſee, in conſequence of this engine, how men, who have ſometimes acquired the reputation of knowing every thing, are not always thoſe of the quickeſt apprehenſion. One, who had ſeen my engine often work, ſaid to Ferguſſon, when he was ſpeaking of the air between cold water and hot ſteam, "Take care of what you ſay on thoſe matters; if it ſhould "not be ſo, you riſk your reputation." To which Ferguſſon replied, "I riſk nothing; Blakey is the inventor of the "intermedium of air between water and ſteam in fire-"engines."

---

* This gave me a hint to combine this principle with a fire-engine, which gives a fall of thirty-five feet to bring up water from two or three hundred fathoms, without a great piſton, buckets, pump-rods, chains, monſtrous beams, &c. which are ſo coſtly in conſtruction and repairs in the engines now in uſe.

Ten years after, examining Papin's works, I obſerved an air-veſſel in his engine; but it was not to make an intermedium to hinder the ſteam from touching the cold water, but only to make a floater.

In 1766, Monſieur Cambray Digny, a French gentleman, made an engine for raiſing ſea water for the ſalt works of Caſtiglione. This machine works only by condenſations. The injection is carried in the cylinders by an ingenious piece of mechaniſm of his invention; if it is not ſo ſimple as ſuch works require, it comes from its being a firſt thought, which this ingenious gentleman had not time to improve upon, and his not being brought up in the practice of the mechanical arts.

In the ſame year I made another engine, which raiſed water by the ſole condenſation of ſteam, with an improvement for ſaving fuel. After it had played a month, I added another receiver to force water higher by the expanſive power of ſteam. After this engine I made another; but, from an œconomical motive, the perſon who ordered it wanted it to be of caſt iron; for which reaſon I ſent my laſt engine to the iron-works, to give an idea of what was to be done.

When the caſt-iron engine was ſet up, (the cylinder ſerving for *boiler* and *air-veſſel,)* it was ſet to work; but, as the fire was increaſed in order to augment the power, the caſt iron could not bear that alternate action of heat and cold, which made it crack and let out the ſteam, though the cylinder was an inch and a half thick, *two feet* in diameter, and *ten feet* long. This ill ſucceſs made me return to copper for making engines, which metal is cheaper than caſt iron, from its lightneſs, ſtrength, and facility of working, and from its loſing little of its intrinſic value; herein very different from caſt iron, which loſes more than ſeven-eighths when ſold as old iron: beſides thoſe inconveniencies, caſt iron is corroded twenty times ſooner than copper.

After this it was determined to make an engine entirely of copper for a coal mine; the engine was made in proportion to what the depth of the pit was repreſented to be. I had it ſet up in my garden at Pimlico, where it performed its part as I deſired, and was ſent to the country; but, when it was on the ſpot, I found the pit to be more than double the depth of what had been ſaid, which obliged me to ſtrengthen the whole; the reſiſting column being 27,000 lb. weight, inſtead of 12,000. The repairs took much time.

When finiſhed, buſineſs called me to Paris. Here I made an engine, which appeared ſuch an extraordinary thing that numbers came to ſee it. Before this engine was made, I had placed all my writings for the inſpection of the Royal Academy of Sciences, which did me the honour to approve of my work.

The Duke de Charters, now Duke d'Orleans, hearing of this engine, ſent for me, to know if I could procure him water in an artificial river which he intended to have in his garden (ſeventy-two feet higher than any water in the wells of the country). I replied, that I believed I could ſatisfy his wants, and at the ſame time invited him to ſee my engine play: next day he came, and was ſo well pleaſed, that he gave orders that every thing I wanted ſhould be had.

At firſt ſight it appeared, that two engines were neceſſary, but a day or two after I let him know, that I could do his buſineſs with one, which pleaſed him much. While it was making, he came more than twenty times to ſee how things went, on, always expreſſing great ſatisfaction, and making the model play when he brought company.

When the Prince's engine was finiſhed, pipes were laid to carry water into a baſon on a hill a hundred fathom from the engine. The water thence fell on an over-ſhot wheel, to work a couple of pumps in the well, which brought up water ſeventy-two feet, and diſcharged it into the head of the river, at the end of which was the fire-engine. This raiſed the water again, and ſent it through the pipes as before, and thus cauſed a continual circulation of water from the pumps to the river. This engine pleaſed me the more as it was the firſt I made to work itſelf, having looked on the mechanical part but as an acceſſary to the principal, which laſt is the moſt eſſential, as all the power to be had in theſe engines comes from fire.

The Prince was extremely pleaſed to ſee his engine work ſo well, and gave a gratuity to the workmen. I alſo made for him a ſmall engine to be placed in a chimney to work the bellows of an organ; it was intended to act only by the expanſion of ſteam. The firſt time I made it play, its piſton being arrived at its utmoſt limit, I was ſurpriſed to find the ſteam condenſe iſelf, by which means I had no waſte water as the condenſed ſteam returned into the boiler; thus the piſton worked backwards and forwards with the ſame force; which made me look on this invention as my *chef d'œuvre*. In ſhort, I found it to be of ſuch conſequence, that I took it to pieces out of ſight of the workmen.

After this engine, I made another for the uſe of *jets d'eaux*, with improvements. I likewiſe made one exactly like that in the *Duc de Chartres*' garden, but on a ſmaller ſcale, and portable. It was for a friend of Mr. Bertin, miniſter for the department of mines and manufactures, &c. it was carried to his hotel, where it played a couple of hours before a number of ſpectators. Next day it was carried to the Hotel Toulouſe, and placed on a baſon in the garden of that palace, where the *Duc de Penthievre* ſaw it play *an hour and a half*, ſo taken was he with the novelty.

I had another engine made for the ſame perſon, which raiſed water twenty-one feet by condenſation of ſteam, and afterwards forced it up thirty feet higher by the power of expanſion. I went on gradually improving, both as to principles and œconomy in conſtruction, as well as in ſaving fuel; which may eaſily be conceived, when it is conſidered what a large field the variety of fire-machinery has to play in. All theſe conſtructions demonſtrate how little the philoſophical and mechanical principles of the art of fire-machinery have been attended to, ſince the lever-engine has been invented; as they prove at the ſame time how much we are ſubject to keep to the routine we have been trained in, and that few men appear capable of invention.

Theſe engines I uſed occaſionally to ſet to work all at one time, which cauſed a variety of pleaſing effects to thoſe who had a taſte for ſuch ſtudies. This procured me more and more viſitors: one of them ſaid, "Dont you make theſe engines act at once on purpoſe, that their operations may not be conceived?" which queſtion ſurpriſed me, having never made them work but to conſider their effects, and to improve on them.

I made another for a marble ſaw-mill; the owner of which, Mr. Bertin's friend, was then in the low countries; I ſent him his portable engine, which he made to play before Prince Charles, Governor of the Auſtrian Netherlands, who gratified the owner in a princely manner.

Some time after, I ſent his engines to Holland, and joined to them one of my own, having been written to for this purpoſe from Rotterdam. As I was on my way to England I paſſed through that city, where I ſaw Mr. Hogendyck, who was ſetting up a lever-engine for draining the water out of low lands; he received me very politely, but was rereſerved, fearing that my arrival might hurt his views. He put many queſtions that ſhewed his little experience in Fire-Machinery, and that what Mr. Vanlinder (Mr. Hogendyck's agent) had written to me, was for no other purpoſe than to know how to go on with their undertaking.

Having made my obſervations on what was to be done with the overflowed lands, I ſet out for Leiden, with a letter to Monſieur Allaman, profeſſor of natural philoſophy at that univerſity. This gentleman put me in the way of being acquainted with the firſt people of Amſterdam, after which I ſet out for England.

On my arrival in London, I heard that Meſſrs. Watt and Boulton were petitioning Parliament for the renewal of a patent for a fire-engine. A friend of mine, thinking thoſe matters were on my principles, oppoſed the demand; but, when I came to know the nature of their contrivances in the lever and piſton way, all oppoſition was laid aſide.

After I had done my buſineſs in England, I returned to Liege, where I was offered a connection with a worthy nobleman of that ſtate, for ſetting up a manufactory of fire-engines; this offer I accepted, ſet up ſome works, and conſtructed ſeveral engines; one of which was ſent to Holland, under the direction of one who acted in my ſtead, I having then the gout. This engine acted by expanſion and condenſation alternately, it ſerved to give ſome reputation to that perſon who deſired to appear as a philoſopher. Four months after, I went to Rotterdam, and, at the village named Croſwick, I made the engine play ſo well, that the magiſtrates of that city came in a body to ſee it work, from whom I received many compliments, and was carried back to town in their yacht. In ſhort, this engine made ſo much noiſe, that all the virtuoſi of Rotterdam thought themſelves much favoured when they could have a ſight of it.

This public approbation occaſioned the engine to be ſent for at the Hague; it was accordingly ſet up in the cow-field, in the park of that town, and ready to play on the 10th of October, 1776, when the States of Holland ſent a gentleman to let me know that they would go and ſee the engine play at eleven in the morning; accordingly I had the honour to ſet my invention at work, the operations of which were explained to their High Mightineſſes by M. Van Graff, Military Engineer in ſeveral departments; and the Profeſſor in Mathematics, Blaſſiere.

The States returned to their Aſſembly-room, where they ordered a patent for the author of the engine, though the petition had been given in but that day. Such a favour had not been heard of, in Holland, as the conceſſion of a grant the ſame day as petitioned for.

The Council of State, the Ambaſſadors, and the great people of the Hague did me the honour to applaud this engine.

The next day, the Prince of Orange, the Duke of Brunſwick, and the grand penſioner Bleſwick, went to ſee the engine play. The Stadholder was ſo pleaſed with it, that he expreſſed a deſire of having it in his garden in the wood.

When the firſt people of the Hague had ſatisfied their curioſity in ſeeing the engine, without being impeded by the crowd which was on the outſide of the ditches; I thought it neceſſary to give notice, that the next day every body might come. In conſequence of which, I ordered the two centinels from the iron-gate, and left it open, by which means I had the pleaſure of obliging the people at the Hague with more than three hours play of the engine.

To give a notion of the manner in which the States of Holland grant patents, here is a tranſlation of that which they honoured me with.

"After having reflected on the petition, and hearing the "opinions of our committees on new inventions, and being "favourably diſpoſed for the petitioner, and his heirs, &c. we "grant them the preſent patent, for the ſpace of fifteen years "to come, for the ſole making and vending (to the ex"cluſion of any other perſon in this province) fire-engines, "without levers, of his invention: with interdiction to every "one to counterfeit the ſame, in whole or in part, or ſell, or "cauſe to be ſold, theſe ſort of fire-pumps, under the penalty "of three thouſand florins, providing the petitioner has deli"vered to our ſecretary a full drawing, or an exact explana"tion, of the ſaid engine. And we order all thoſe it may "concern to conform to the preſent contents. Done at the "Hague, our great ſeal being affixed to the preſent, the tenth "of October, in the year of our Lord one thouſand ſeven "hundred and ſeventy-ſix. And ſigned, P. V. Blenwick, "Vt. by order of the States; being ſigned O CLOTTER"BROOKE. By the ſide was the drawing and deſcription "mentioned at the end of the patent, which were depoſited "at the Secretary's office of their noble and mighty powers, "under No. 58, ſigned Clotterbrooke, having the ſaid ſeal "in red wax faſtened to a ſlip of parchment."

"This is faithfully tranſlated from the Dutch, and is in "ſubſtance like the original, by me underwritten, Notary"public and Tranſlator at the Hague, in Holland, the 18th "of November, 1776."

After I had ſtaid a few days more at the Hague, I returned to Liege, to order an experimental engine for my friend Allaman, who had put me in the way of obtaining the patent; which being done, I returned to Holland, and ſet it up at the Univerſity of Leiden, where the profeſſor made it play in public.

Afterwards I heard the port of Amſterdam was filling with mud, and that Mr. Allaman was commiſſary for examining how to prevent the evil from encreaſing, on which I wrote the following letter.

" *To Monſieur Allaman, Profeſſor of Natural Philoſophy* " *in the Univerſity of Leiden.*

" DEAR SIR, *Hague, July* 16, 1777.

" I have examined the Port of Amſterdam ſince I had the " honour of ſeeing you; the more I look into this matter " the more I am perſuaded of the facility of unmudding the " whole; and that without making dikes, &c. which can " only increaſe the evil rather than mend it, as you will ſee " by what follows.

" Every bay which has no river or current to waſh what " may ſubſide in it, as in the caſe of the Tye, retains mud " at every tide, becauſe the ſea allows near two hours reſt " for the water to ſettle: and as the S. E. winds ſeldom " blow as to drive back what the N. W. winds bring into " the Tye, it at laſt muſt fill. Add to this, the great quantity " of mud and filth which paſſes from the canals of the city " into the port. This, and what is driven into the tide, both " tend to the ruin of the navigation of the Tye. Theſe being " the natural cauſes which increaſe the growing evil, " here follows what art may do.

" The dikes, which are intended to be made, will not " give ſufficient impetuoſity to the water for driving the " mud backwards and forwards that is wanted to be got out; " this will of courſe ſettle at the end of the current, and " thus fill up the entry of the Tye; as may be proved by " London-bridge, where, though the rapidity of the water " drives all before it, yet, when it ceaſes, thoſe materials " ſettle, and thus make ſhallows above and below bridge.

" To obtain a current for carrying off the mud from the " port, its velocity muſt be much quicker than it is at preſent; for which reaſon, the dikes, or jettees, muſt come " half over; this will cauſe an obſtruction to the ſea water, " and hinder a great part of it going into the Tye; juſt as " the two-feet fall at London-bridge hinders the tides from " running up faſter and higher up in the Thames. Beſides

" this check, given to the current, it will oblige all the ſhips
" in the port to ſhift about at every ebb and flood of the tide.
" Judge you then, Sir, what inconveniences would attend
" ſuch doings; and what trouble it would cauſe when the
" tide riſes with the N. W. winds, which make the water
" to riſe eight or nine feet above the pile, threatening
" Amſterdam with a general inundation.

" From what has been ſaid, Sir, it is eaſy to conceive,
" that an accelerated current in the port would be a nuiſance
" to the ſhipping, and help to ſend the mud from the canals
" of the city into the Tye, as well as to choak up the Pampus, and hinder the S. E. winds, which blow but ſeldom,
" from driving back what the N. W. winds bring in ſo frequently. This ſcheme therefore will ſecond nature in
" effecting what every Hollander dreads.

" You know, Sir, that my plan is very different, it can
" unſand or unmud, at any depth, in dead water as well as
" in a current; by which means it gives an opportunity, at
" every tide, to carry off what is ſo great a nuiſance, and
" this without making it ſettle in the Pampus; the muddy
" water, which muſt be let out from the canals of the
" city, is to give room to the freſh water coming from the
" Amſtel, which will be enough to carry every thing out of
" the port at each tide, as I have explained to you, and this
" can be done without cauſing any hindrance to the draining of the lands, or endangering the cellars of Amſterdam

" I have the honour to be,
" SIR,
" Your moſt humble ſervant,
" W. BLAKEY."

Mr. Steenſtrea, ſupported by one of the ſtrongeſt parties in Amſterdam, and looked upon as the moſt ingenious and learned man of that city, was the projector of the unmudding the port with dikes; he exclaimed againſt all ſorts of engines, and ſaid it was impoſſible to have freſh water in the canals of that town by any other means than raiſing the inland waters three feet higher than they actually were. This afforded me an opportunity of giving him a public anſwer, and of ſhewing the neceſſity of having freſh water in the canals to take off the peſtilential vapour which always riſes from them, and cauſes a great number of deaths.

" To

“ *To Monſieur le Roy of the Academy of Sciences at Paris.*

“ DEAR SIR,

“ Mr. Steenſtrea, who pretends to univerſal knowledge, ſays, that engines are not proper for bringing freſh water into the canals of Amſterdam, and that it is impoſſible to have any current in them without raiſing the waters of the Amſtel three feet higher than they are, which he ſays is very eaſy to be done; this is believed by ſome of the magiſtrates to be practicable.

“ Rightly to underſtand the merits of theſe aſſertions, you muſt know that Holland is lower than the level of the ſea, excepting the ſandy downs on the ocean ſide; and the lands, in ſome places, are many feet lower than the ſea even at low water. This ſituation has neceſſitated the people to make cauſeways, which are called dykes; they ſurround all the rivers and their branches; and even the inlets of the ſea. Theſe dikes are the common roads; and, what is ſurpriſing to ſtrangers, theſe roads are paved with ſmall bricks edge-ways; theſe roads are but juſt broad enough to let two carriages paſs, or go by one another without danger.

“ Another obſervation to be made is, that all the lands, whence clay has been taken to make bricks, have very extenſive excavations which are full of water; and, as Holland has no fuel but turf, which is taken from the low grounds, theſe hollows are again full of water. Thus the perſon, who is on a ſteeple or high building, ſees the fields and houſes like an overflowed country, which every ſtorm of rain and wind menaces with ruin. This has actually happened near Haerlem; which lake or ſea threatens to deſtroy Amſterdam when the S. W. winds blow hard.

“ Such a ſituation makes the land in Holland very dear, the draining of an acre of land coſts one guinea a year; which ſhews what profits ariſe by extracting the waters from this country. This, however, can be eaſily done with wind mills and fire-engines; the dikes being already made to hinder the water from coming back after they have been thrown out.

" Having given you a notion of the ſurface of the country, " I muſt inform you that Amſterdam is on the ſouth ſide of " a ſtreight, or inlet, which goes from the Zuyder Zee to " the Tye. This inlet is the port of Amſterdam. The " Tye hinders the tide from going farther up the land, the " common tides do not riſe more than one foot or eighteen " inches, ſo far is the Texel from the port. The water is " ſo long running back, that it is low water at Amſterdam " when it is high water at the Texel, according to a learned " Dutch gentleman, who is general inſpector of the dikes in " Holland, and who gave me this account.

" You muſt know alſo that the figure of Amſterdam is " like a bow in half a circle, the ſtring of which is a dike, " nine and ten feet higher than the pile, which I ſhall ſpeak " of ſoon. The city is divided by a number of canals, " which run nearly parallel one within the other from the " grand dike to the ramparts. What is between the canals " are the quays and ſtreets, all the canals communicating " one with the other; but there is no circulation of water " in them. This cauſes vapours to riſe with a ſcent more " diſagreeable than can be imagined from the filth which is " thrown into them every day. The ſtench, in hot weather, " is ſo ſuffocating, that one can hardly bear it in many parts " of the town. At the end of each canal there is a ſluice " with flood-gates, which lets craft go in and out from the " port to the canals; but, as ſoon as the water is level with " the pile, they are ſhut to hinder the tide coming into " them. The gates of ſome canals are open, for the ſhips " to go as far as the ramparts and into the Amſtel, and " thence up the inland canals, and into the lake or ſea of " Haerlem.

" This watery ſituation is ſo dangerous for Amſterdam, " that the cellars of every houſe are liable to be over- " flowed, if any negligence take place; for which reaſon a " pile is placed at every ſluice-gate; its firſt mark is *two* or " *four* inches under the channels of the cellars or ware-houſes " which let the water run out of the ciſterns into the canals " when it rains. If the water riſes in the port above the firſt " mark on the piles, the flood-gates are ſhut, by which means " the veſſels can neither go in or out, and the boats *, which " bring proviſions, are obliged to unload at the South ſide " of the dike when they come from North Holland, &c.

---

* All the proviſions for Amſterdam are carried in boats, which come from far and near to the market-place, or down the country on the Amſtel, &c.

“ From this low ſituation of the lands we may eaſily conceive
“ that rain would ſoon overflow the country if there
“ were not means to carry the water off. Theſe are windmills;
“ of which there are 94, which throw up water into
“ the Amſtel. In windy weather, they raiſe water at the rate of
“ 20,000 barrels a minute, the barrel weighing 360 pounds;
“ from which you ſee how every body in Amſterdam would
“ be diſtreſſed if the flood-gates of the canals were ſhut to hinder
“ the water (which comes from the ninety-four windmills)
“ from running into the port, which ſometimes happens
“ when the wind is N. W. * this greatly endangers the
“ cellars of this city.

“ That you may better underſtand the danger of letting
“ the waters riſe in the canals, you muſt know that the
“ under cellars in every houſe are 55 inches lower than the
“ pile. In the upper and under cellars the handicraft people
“ live. From what has been ſhewed it is eaſy to perceive
“ what diſtreſs the inhabitants of this city would be in, if
“ the tide was ſuffered to run into the canals, which tide I
“ have ſeen riſe eight and nine feet above the pile when the
“ N. W. wind was ſtrong; and what would be the fate of
“ one hundred thouſand mortals who inhabit thoſe ſubterraneous
“ places.

“ To guard againſt ſuch dangerous floods, there are centinels
“ night and day, who watch and ſet down on tables,
“ at every hour, what height the water is above or below the
“ pile in the port and in the Amſtel, which tables are carried
“ every morning to the magiſtrates and the directors of
“ the works: this police in ſtormy weather gives much trouble
“ to the magiſtrates, who are on the watch where danger
“ ſhews itſelf.

“ Having given you an idea of the ſituation of Holland,
“ and the danger of letting the waters into the canals of Amſterdam,
“ I will next examine the conſequences of Mr.
“ Steenſtrea's plan in making the water riſe three feet higher
“ in the Amſtel. The firſt is, that ſluices and flood-gates
“ muſt be made as well as dikes to ſurround the Amſtel, and
“ every ſtream that runs into it, otherwiſe the lands would
“ be overflowed, as they are lower than the canal in which
“ the veſſels navigate.

---

* The cellars and ciſterns in Holland are built with bricks and mortar, which are water-proof, ſo that nothing can penetrate them from without ſide, nor can the water in them be got out but by hand. The inhabitants of Amſterdam have no freſh water but what comes from rain, or is brought in bottles and boats; the brewers of the city fetch their water at the diſtance of four leagues.

“ Beſides, the 94 wind-mills muſt be made to throw the water three feet higher than they do at preſent, which is a matter worth notice, as every one of theſe mills coſts no leſs than 12,000 florins. We will ſuppoſe the dikes made, and the mills doubled in power; ſtill this philoſopher cannot put his invention in practice but in winter and rainy weather, which would encreaſe the danger that always threatens the cellars of Amſterdam, when the leaſt N. W. wind blows.

“ But what muſt be done in ſummer to have water three feet higher than uſual, when there is not enough for the preſent inland canals, or pretended river which is called Amſtel, and which is fed by no ſource or ſpring? How could he reſtore the water which evaporates in hot weather? and that which runs out in the paſſage of a multiplicity of boats and veſſels going through? in ſhort, how could he have water to ſupply the canals of Amſterdam, and give it a current to clean them?

“ I will again ſuppoſe that this engineer's project is approved; where can he find materials to make the dikes broader, and raiſe them three feet higher, in a country which has not half materials enough for building and repairing the preſent houſes, &c. much leſs to make dikes, which require ſeveral thouſand times more materials than for erecting dwellings. From what has been ſaid, every one muſt conclude that this projector is very unſkilful in hydraulics, and that he is no Hollander; if he is, he has no notion of the locality of this country, and does not underſtand its conſtitution, where property is ſo well preſerved to every individual. From which I ſhall conclude, that Mr. Steenſtrea has no proper idea of what is to be done with machines, or by the help of nature.

“ But what appears very extraordinary is, that, among the friends of this would be engineer, a doctor in medicine ſays, that the vapours, which ariſe from the ſtinking waters of the canals of Amſterdam, are not prejudicial to health, and that it is needleſs to clean them.

“ I am far from thinking that the whole. faculty believes in ſuch an hypotheſis; but if any one would try to perſuade me that the vapours full of myaſms of diſtempers, which riſe from the canals, can cauſe no harm, I ſhould inſtantly ſay that he was unfit to be a diſciple of Eſculapius, and that he had never found ſuch contradictions in Hypocrates's aphoriſms; and I dare ſay, that, if this celebrated Greek had ſeen the number of faces muffled up,

"with plaſters on the cheeks, and the multitudes confined
"to their beds by the diſtempers ſo common at Amſterdam,
"that he would have thought otherwiſe than the modern
"doctor, who I ſuppoſe triumphs when the great number of ſick create him employment. I ſhall ſay more;
"Hippocrates would never have ſuppoſed that a putrid atmoſphere loaded with myaſma of diſeaſes, as I have ſaid,
"and with vapours ſo corroſive and putrid, that they
"deſtroy in one night's time the paint of a houſe, I repeat
"again that Hippocrates would never have ſaid that ſuch vapours were not dangerous *.

"I am, my good friend,

"Your moſt humble ſervant,

"W. BLAKEY."

Mr. Steenſtraa's party being the ſtrongeſt, they made the burgo-maſters conclude, that fuel was too dear for any engines whatever, though one had been prepared, and raiſed 540 gallons of water at every condenſation. The deſcription of which is inſerted in the academical works, with all the detail neceſſary to ſhew how a cylinder can be made to ſerve for a boiler and receiver alternately.

In 1780, I erected another engine for caſcades and fountains. The next was made for a rolling-mill; it raiſes *ſeven thouſand* pound weight of water at every condenſation, which falls on two wheels, one of 15 and the other of 16 feet diameter. The waſte heat coming from the furnace, in which the metal is made red-hot, cauſes water to boil, which gives more ſteam than is wanted to work the engine. From the ſimpleneſs of the conſtruction of this invention it coſt much leſs than half of what a common one of the ſame ſize would come to. I made another for a corn-mill. All theſe contrivances are in the hiſtory, theory, and art, of fire-machinery.

---

* A gentleman writing to his friend at Amſterdam in July, 1719, deſired to know how he found himſelf with the ſmell of the canals in this hot weather. His anſwer was, that, for two months, there had not been a houſe without ſick, and that the liſt of the dead had increaſed to three hundred and two in lieu of one hundred and twenty a week. My two children and wife are ſick; ſhe has a fever which preys upon her ſadly. A French gentleman of my acquaintance was ſeven weeks at my houſe, and narrowly eſcaped death, after forty days illneſs in bed; ſo you may judge how the execrable ſtench of the canal has amuſed me.

PROPOSALS

FOR PUBLISHING, BY

SUBSCRIPTION,

The Hiſtory, Theory, and Practice, of Fire-Machinery,

WHICH GIVES MOTION TO MILLS,

TO

MECHANICAL AND HYDRAULIC INSTRUMENTS,

WITH OR WITHOUT WATER-FALLS.

IN QUARTO.

THIS Treatiſe is an elementary Work founded on the principles of Nature. We ſhall lay before the reader what the Academy of Sciences ſays of it.

From the REGISTER of the ACADEMY, Sept. 5, 1772.

" By Order of the Academy, we have examined Mr. " BLAKEY's Art of Fire-Engines, or Treatiſe on different " methods of making uſe alternately of *expanſion* and *condenſation* of ſteam, to be uſed in Mines or in other places, " ſo as to furniſh Reſervoirs for Fountains and Water-" Works, to fill and empty Ponds, to turn Mills, and make " Canals navigable.

" The World has long ſince wanted a Work, which " comprehends all that regards Fire-Engines; this Mr. " BLAKEY has done in the Treatiſe we are going to give " an account of.

" After a ſhort Preface, in which the Author ſhews " the order he intends to follow, comes the Work itſelf, " in Two Volumes. The firſt is divided into Five Parts: " In the firſt, he gives an account of what is moſt worthy " of notice, as to the Hiſtory of theſe curious Machines: In " the ſecond, he ſhews the Principles on which their Effects " are founded, and joins to it the Deſcription of ſeveral " Engines: In the third, he treats more at large of the Principles which relate to them: In the fourth, he ſhews the

" manner of making theſe Engines, and enters into the par-
" ticular parts which are neceſſary for the Conſtruction of
" them : In the fifth Part, he treats at large of what is
" neceſſary to make Fire-Engines anſwer in the various
" manners they are to be made uſe of.

" The Second Volume will have Tables of Proportions
" neceſſary for thoſe Engines, and various others for raiſing
" Water, in order to turn Wheels for Rolling Copper,
" Iron, and Sugar Mills.

" By what has been ſaid, it is ſeen, that the Author has
" taken into his Plan all that can be deſired on the Subject
" of theſe curious Engines ; he has not confined himſelf
" only to ſhew the Rules and Principles made uſe of in the
" Fabrication, but he enters, as much as is poſſible, into
" what is neceſſary to enable any one to make them. Not
" content with that, he gives the deſcription of ſeveral
" Fire-Engines, known by the name of the *ſimple kind*,
" which he has brought to ſuch Perfection in their con-
" ſtruction, that the Steam is not condenſed by the contact
" of cold Water.

" From what has been ſaid it appears, that Mr. BLAKEY
" has treated this Art with all the extent and exactneſs that
" ſuch an important matter requires ; in conſequence of
" which, we think him worthy of the Academy's approba-
" tion, and that his Works merit being publiſhed with
" thoſe it gives to the Public.

(Signed)

" DE VAUCANSON, LE ROY, ET LE CHEVALIER D'ARCY.

" I certify the above Extract to be ſimilar to the Ori-
" ginal, and agreeing with the Judgement of the
" Academy.

" GRAND JEAN DE FOUCHY,
" Perpetual Secretary of the Academy of Sciences."

Paris, Sept. 14, 1772.

Here follows the Copy of the REPORT made to the ROYAL ACADEMY of ATCHITECTURE.

" We, Commiſſioners named by the Academy to examine
" the effects of Mr. Blakey's Fire-Engine, ſaw it perform
" on the 13th of July, 1772 ; and it appeared to us, that
" it was free from Piſtons, Leavers, Chains, Rods, Pul-
" leys, and other implements which are looked upon as ne-
" ceſſary in machines for raiſing water, which acceſſary parts
" take off a great deal of the active power from the friction
" and internal reſiſtance they occaſion.

“ Mr. Blakey has no other power to overcome but the
“ weight of the water he intends to raiſe, excepting the friction
“ of the cocks. It appears to us, that the manner in which
“ he makes uſe of air, as an intermediate agent between ſteam
“ and water, is of his own invention, which has the ad-
“ vantage of preſerving the ſteam in almoſt its whole ex-
“ panſive power as when it comes out of the boiler, which
“ elaſtic power it would loſe were it to come in contact with
“ cold water.

“ From the conſtruction of this Engine, it appears to
“ us, that he is able to make one in which he may com-
“ preſs the air to the degree he thinks is neceſſary to with-
“ ſtand the greateſt trials, in a fixed place. By this method
“ he loſes no more of the expanſion of the ſteam than what
“ touches the inward ſurface of the receiver, which may be
“ looked upon as a mere trifle, as the ſteam is continually
“ accumulating as faſt as the water is driven out.

“ From theſe obſervations, we believe that this Engine
“ is more proper for raiſing water than thoſe worked by
“ hand or with cattle, and even better than thoſe of the
“ ſame kind made uſe of before this invention; becauſe the
“ quantity of water raiſed appeared to us very conſiderable,
“ in proportion to the fuel burnt. This Engine takes little
“ room, from the ſimplicity of its make; it has no limit as
“ to its power, it is not ſubject to the variation of the air,
“ and requires no expence to keep it in repair when ſtanding
“ ſtill. In ſhort, we believe this Engine would be very
“ advantageous, were it made more ſolid *, ſo as to be able
“ to make the experiments requiſite for aſcertaining to what
“ degree the expanſion of ſteam can be carried without
“ danger.

“ The known capacity of Mr. Blakey leaves no doubt,
“ that in a large one he will manage it in ſuch a manner as
“ to make the ſteam act upon the Engine, ſo that it may
“ work itſelf without the help of any agent.

“ Signed
“ Peronet †. “ Mauduit ‡.

“ I certify this to be conformable to the original.
“ Sedain, Perpetual Secretary of the Academy, March
“ the 9th, 1772.
“ And on the 22d of March I laid the whole under
“ the inſpection of the Academy who approved the
“ ſame. Sedain.”

---

* This Engine raiſed eight gallons at every condenſation, its cocks were turned by hand, and it was only placed on a well without any fixtures; at every expanſion, it forced up the ſame quantity without the loſs of one drop of water.

The cauſe of this work's not being printed when the Academy adopted it was, Mr. Saillant's (the Printer and Bookſeller for the Academy) not agreeing with the author: This made Mr. Blakey reſolve to publiſh his Works himſelf, and have the Plates engraved by the beſt hands in Paris. His Twelve Plates of the art of Watch-ſpring-making were firſt engraved accordingly, and they were copied into the *Encyclopédie Méthodique*, printed at Paris, by Pankouk, who copied indeed the whole performance, word for word, even to the very approbation of the Academy.

The author, not having time then to attend his work on Fire-Engines, laid it aſide; but the lapſe of twenty years has given him the opportunity of making ſeveral Engines, in large and ſmall proportions, the largeſt of which raiſes *three tons and a half* of water at every *condenſation*. All theſe Engines he has inſerted in this Work. Which has given occaſion to increaſe its uſefulneſs by explaining the above-mentioned powers, which have not been ſo well underſtood as ſome Theoriſts and Engine-builders have advanced.

The Author has been more than thirty years collecting the neceſſary materials for ſuch an extenſive art. His knowledge is wholly practical, being founded on more than half a century's experience in Mechanical, Hydraulic, and Philoſophical, &c. Works. As he has ever kept them private, he is perſuaded the reader will find a greater variety of methods in applying the above mentioned powers than ever have been publiſhed, both as to the œconomy of fuel and conſtruction of the Engines; in the manner of applying air to raiſe water where the elaſticity of that element is powerful enough for raiſing water 100 feet, it is made to force up water from ſeveral hundred fathoms without any other mechanical implements than what is neceſſary for opening and ſhutting the valves and cocks.

This Treatiſe is the more proper for beginners, as it is not encumbered with the opinions of inexperienced theoriſts, who make a parade of profeſſing a better method to find out proportions and rules than true practice with common Arithmetic, and thus render their works uſeleſs to thoſe who have the moſt want of them. On the contrary, here the matters are eaſy to be underſtood, and fit for the ſtudy of youth, or any who deſire to have ſome knowledge in the powers Nature gives, by means of *Water*, *Fire*, *and Air*.

---

* Monſieur Peronet is director of the Engineers of the *Ponts* and *Chauſées* of France; he is the author of the Deſcription of the Lever Fire-Engine in the Paris Encyclopædia.

† Monſieur Mauduit is Profeſſor of Geometry in the Academy of Architecture, and Lecturer in Mathematics of the *College de Navarre* at Paris.

This Work is divided into Five Parts, to be delivered at as many periods. The firſt, ſix months after the Subſcription is filled; and the other four parts to be delivered every three months following.

The firſt Part contains the Hiſtory of Fire-Machinery, from the firſt notions we have received from the Greeks to theſe days; this part will have Sixteen Plates. The Second Part has an equal number of Plates.—The Third Part will have as many, on the Author's own experiments.—The Fourth Part will ſhew how to make Fire-Engines in the moſt ſimple manner, with all the Plates neceſſary for that purpoſe. —The Fifth Part has Sixteen Plates of Engines for Fountains, Gardens, Mills, and for turning Rollers, for plating Metals hot and cold, and bruiſing Sugar Canes. Theſe laſt Engines require no other heat for working than that which proceeds from the Furnaces which contain the Sugar-Boilers.

The Subſcription will be received by Meſſrs. *Egertons*, Charing Croſs; *Elmſly*, and *Cadell*, in the Strand; *Taylor*, Holborn; *Robinſons*, Pater-noſter-Row; Mr. *Richardſon*, Royal Exchange; Mr. *Nichols*, Red-Lion Paſſage, Fleet-Street; and by the Author, No. 3, Northumberland-Street in the Strand; who will give Receipts for the delivery of each part.

The payment for each Part is Eighteen Shillings; Ten and Sixpence on Subſcribing, and the other Seven and Sixpence on receiving the Firſt Part; and ſubject to the ſame Conditions for all the other Parts.

A Liſt of the Subſcribers Names will be printed with the Work.

* * *